

EXECUTIVE SUMMARY

DOCUMENT DESCRIPTION

This document presents a Remedial Action Plan (RAP) prepared in accordance with the *Imminent and/or Substantial Endangerment Determination and Remedial Action Order (Docket No. I/SE 98/99-011)* (Order) issued on June 1, 1999, by the California Environmental Protection Agency (Cal/EPA), Department of Toxic Substances Control (DTSC). This RAP is based on the findings and recommendations contained in the remedial investigation/feasibility study (RI/FS) (Earth Tech, 2001b). The RAP describes and evaluates the preferred remedial action alternative for the Project Site in accordance with the state of California and U.S. Environmental Protection Agency (EPA) criteria.

PROJECT SITE

The 220-acre Project Site includes features known as the South Valley, Ridge, North Valley, and the D-1 Parcel. Figure ES-1 identifies the locations of these features and the identified areas of interest. In 1996, the majority of the Project Site had been fenced with controlled access through security patrols. In 1999, the entire Project Site, as described herein, was fenced and access was controlled.

BACKGROUND

From 1849 through 1958, the United States acquired, by lease, license, or fee, over 2,700 acres in Benicia, Solano County, California, for the former Benicia Arsenal. The former Benicia Arsenal began at the shore of the Carquinez Strait and extended northward. Over its 100-year history, the former Benicia Arsenal was used as a principal depot for ordnance storage, issuance, and transshipment. The Tourtelot Property (which is contained within the Project Site) consists of approximately 200 acres of undeveloped grassland situated in the northwest corner of the former Benicia Arsenal. The Tourtelot Property was leased to the Army from 1944 to 1960; for that period of time the property was part of the Benicia Arsenal. From 1945 to 1960, the Army conducted several arsenal-related activities on the property, including artillery testing, demilitarization, and demolition of damaged and obsolete munitions.

After the arsenal was closed in 1964, the Tourtelot Property changed ownership, and plans for private residential development were initiated. In 1990, grading activities were conducted on the Project Site. Soils were cut from the Ridge, the McAllister Drive Land Bridge was constructed, and the Unit D-1 lots were graded. In 1996, concrete-filled howitzer shells and live ordnance were discovered on the Project Site. This finding prompted the developer of the property, Granite Management Corporation (Granite), and the U.S. Army Corps of Engineers (USACE) to characterize the site for ordnance and explosives (OE) and chemical impacts to soil and groundwater.

INVESTIGATIONS PERFORMED

The first part of this document presents the results of the historical and geotechnical investigations at the Project Site. USACE conducted historical investigations of the former Benicia Arsenal, including the Project Site, in 1994, 1996, and 1999 (see the March 1994 Archives Search reports [ASRs] [U.S. Army Corps of Engineers, St. Louis District, 1994a and 1994b], the May 1997 Supplemental ASR [U.S. Army Corps of Engineers, St. Louis District, 1997], and the 1999 Records Research Report [Jacobs Engineering, 1999]). In addition, USACE performed an engineering evaluation/cost analysis (EE/CA) in 1999 to evaluate potential OE, and assess safety risks at the former Benicia Arsenal. In fall 1996, Granite conducted a geophysical survey over the entire Project Site, excluding the cut portion of the Ridge, the west portion of the South Valley, and the wetland area in the South Valley, in order to assess the distribution of metallic anomalies. An additional geophysical survey of select areas throughout the Project Site was conducted by USACE in 1999.

The geophysical surveys identified potential surface and subsurface metallic anomalies at the Project Site. The data collected from these surveys were used by Granite to perform OE clearances in August and December 1996, and to support a USACE OE investigation of the former Benicia Arsenal, including the Project Site and adjacent property, in March 1999. Additionally, during the RI in May 2000, an OE clearance was conducted of proposed excavation locations at the North Valley Military Landfill to facilitate the characterization of soil beneath the landfill. Approximately one-half of the geophysical anomalies cleared from the North Valley Military Landfill were OE scrap. No live OE was encountered as part of this effort.

As a result of previous clearances and investigations, nine OE items related to former arsenal activities have been recovered from the Project Site. No live OE items have been recovered to date from the North Valley. All live OE and OE scrap recovered from the Project Site, outside the demolition sites in the South Valley, were recovered at depths less than 2 feet below ground surface (bgs), except in two areas disturbed by grading activities. The absence of live OE and OE scrap at depths greater than 2 feet bgs indicates that OE at the Project Site would likely be found at a shallow depth. This finding is consistent with the historic use of the open burn activities in the South Valley situated within the Project Site.

The preliminary investigation of surface soil and surface water conducted in 1998 by Granite identified the presence of chemicals of concern (COCs) (referred to as chemicals of interest [COIs] in the July 2001 final remedial Investigation/feasibility study [RI/FS] for the Tourtelot Cleanup Project) in soil at the Project Site. Four investigations were conducted between May 1999 and September 2000 primarily to evaluate the presence of chemicals in the areas of interest identified as being associated with former Benicia Arsenal activities. The four investigations conducted by Granite under DTSC guidance included an interim investigation, RI, data gaps investigation, and the removal action investigation. The investigations

performed to date, with the exception of the removal action investigation, were performed using techniques to avoid metallic anomalies (ordnance avoidance techniques).

Data from these and the previous investigations were used to help define the nature and extent of OE and COCs at the Project Site to the extent possible, based on ordnance avoidance techniques and to evaluate remedial action alternatives.

The Army's historic activities at the Project Site were conducted in the South Valley, the Ridge, and the North Valley. The results of the investigations are summarized by area of interest and featured below:

TNT Strips - North Valley. There are five linear features and one suspected feature on the north hillside of the North Valley, referred to as the TNT Strips. The TNT Strips were used by the Army to dispose of TNT. At two locations along the strips, TNT concentrations exceed 10 percent by weight resulting in these soils being classified as OE. In other areas on the TNT Strips and outside the strips, concentrations of TNT are less than 10 percent, but exceed the Preliminary Remediation Goals (PRGs) established in the RI/FS. Other COCs identified at the TNT Strips include unknown hydrocarbons, polynuclear aromatic hydrocarbons (PAHs), and dioxins/furans (combustion by-products).

Howitzer Test Facility - North Valley. The Howitzer Test Facility was used to test gun barrels by firing dummy/gravel-filled rounds into test tunnels. Low concentrations of petroleum hydrocarbons in the motor oil range, as well as other hydrocarbons (representing weathered fuels) have been detected in the near-surface soil in roads and parking areas at the Howitzer Test Facility.

In addition, low concentrations of petroleum hydrocarbons in the motor oil range and trace levels of petroleum-related volatile organic compounds (VOCs) were detected at depths of up to 10 feet and 20 feet bgs.

North Valley Military Landfill - North Valley. The Army reportedly used this area as a landfill. Wood crates, pallets and packing materials, a crushed metallic structure, and OE scrap were found in this ½-acre area. Low levels of hydrocarbons, VOCs, dioxins/furans, and one pesticide were detected in various soil samples in this area. Trace concentrations of two explosive compounds and one dioxin were detected in grab groundwater samples collected from test pits excavated within the landfill. With the exception of the hydrocarbons, none of these compounds has been detected in the groundwater monitoring wells downgradient of the landfill.

Ammunition Renovation/Primer Destruction Site - North Valley. The Ammunition Renovation/Primer Destruction Site was an area where ordnance was inspected and refurbished, and where ordnance primers were destroyed by burning in a cage. Low concentrations of petroleum hydrocarbons in the motor oil range,

as well as other hydrocarbons, have been detected in both the near-surface and deeper soil.

Two geophysical anomalies in this area have been interpreted as possible underground storage tanks and associated piping, and are thought to represent the source of the deeper hydrocarbon impact.

Dynamite Burn Site - Ridge. Dynamite was reportedly destroyed by burning in this area. No COCs were detected at this site; analysis of the site grading activities indicate that soil from this area was placed in the McAllister Drive Land Bridge.

Flare Site - South Valley. This area was reportedly used to destroy flares by burning. Five metals related to these activities were identified as exceeding the PRGs established to satisfy the remedial action objectives (RAOs) at this site. The metals and their maximum detected concentrations include antimony, barium, copper, lead, and zinc. Dioxins/furans were also detected.

Demolition Site #1 - South Valley. This area was identified as a potential ordnance open burn/open detonation area because of the distribution of metal anomalies. No COCs were detected at this site.

Demolition Site #2 - South Valley. No COCs were detected at this site. In addition, since no physical evidence of ordnance-related activities were found at this site, the site was eliminated from further investigation as part of the RI/FS.

Demolition Site #3 - South Valley. Physical evidence and geophysical studies indicate that this area was used to destroy ammunition by open burn/open detonation. The only COC detected in shallow soil at concentrations exceeding the PRG was mercury.

South Valley Wetland/Sediment - South Valley. The only COC detected in the wetland sediment at concentrations exceeding the PRG was mercury.

Surface Water. Surface water at the Project Site has not been impacted.

Groundwater/Seeps - North Valley. Low concentrations of petroleum hydrocarbons have been detected in groundwater samples collected from one well. Trace levels of explosives, one PAH, and one VOC have been detected in grab groundwater samples and grab seep samples. No explosives, pesticides, or PAHs have been detected in North Valley groundwater wells.

Groundwater/Seeps - South Valley. One explosive compound has been detected once in a groundwater sample collected from a well. No explosive compounds were detected in this well during the recent (August 2000) groundwater sampling event, nor were explosives detected in the first monitoring event (December 1999).

Off-Site Soil Issues. In addition to the impacts listed above within the Project Site boundary, the RI/FS identified two potential off-site issues: (1) adjacent properties to the north and east of the TNT Strips, and (2) off-site fill areas.

All off-site TNT issues will be addressed through confirmation sampling, analysis, and through the post-remediation risk assessment. If necessary, additional excavation of soils will be undertaken. A detailed sampling and analysis plan for confirmation sampling will be included in the Non-OE Remedial Design Document (non-OE RDD), and all analyses performed will be summarized in the Implementation Report required by Section 5.13 of the Order. The Implementation Report shall be approved by DTSC prior to certification and closure of the Project Site.

Soil originally situated within the boundary of the Project Site was moved off site during grading activities in 1990. The soil was used as fill material under residential subdivisions situated south and west of the Project Site. It is not known if the soil transported off site contained OE and/or OE scrap. Information on the distribution of OE and OE scrap obtained during the point clearance activities (investigation of OE and metal anomalies) on the Project Site, as well as the adjacent Gonzales property to the east of the South Valley, will be evaluated to define the final OE Site Conceptual Model (SCM). This model will be used to assess the potential for OE-impacted soil to have been transported off site.

Granite will develop the final OE SCM based on the above data that will be reviewed and agreed upon by DTSC. The final SCM will be based on data collected during the project point clearance phase of the OE investigation and remediation at the Project Site, which is scheduled to begin in late fall 2001, and during the work at the former Benicia Arsenal, which began in May 2001. Evaluation of the data may be available in the first quarter of fiscal year 2002. Based on the final SCM and consistent with USACE procedure, if DTSC determines that OE was distributed to residential areas outside the Project Site boundary and, as a result, there is a risk that OE items can be encountered in a manner presenting a significant risk of injury or death, then, concurrent with the areawide clearance phase of work activities, a plan will be developed in accordance with an order or agreement to identify and address these off-site areas. This plan will be presented to the public. If required, the plan will include an analysis of response alternatives for these areas. Response alternatives may include development of a Community Awareness Plan to educate the public, institutional controls, surface clearance of OE, and/or detection and clearance of OE to depth.

HEALTH RISK ASSESSMENT

A screening-level Health Risk Assessment (HRA) was performed by Granite under DTSC guidance to assess the potential risks to human health and the environment associated with chemicals at the Project Site. This assessment was based on data collected during the RI. The primary objectives of the screening-level HRA

were to: (1) evaluate potential human health risks based on current Project Site conditions; (2) identify PRGs for those chemicals that contribute significantly to potential human health risks, or are present at concentrations greater than ambient levels; and (3) demonstrate that the proposed PRGs will also be protective of ecological organisms.

A Human Health Screening Assessment of current Project Site conditions was conducted separately for COCs in soils in each area of interest as well as for COCs in groundwater and surface water in the North Valley and/or South Valley. This screening assessment was based on maximum detected concentrations and readily available regulatory screening criteria (U.S. EPA Region IX PRGs). For COCs in soil, the screening excess cancer risks ranged from 2×10^{-2} to 5×10^{-7} , depending on the area of interest and whether the naturally occurring metal, arsenic, was included in the calculation. The non-cancer hazard index ranged from 40 to 0.009, depending on the area of interest and whether the naturally occurring concentrations of iron and manganese were included in the calculation. The chemicals that contributed most significantly to the screening risk estimates included explosive compounds in the TNT Strips, PAHs in Stockpiles #1 and #2 at the Ammunition Renovation/Primer Destruction Site, and dioxins and several metals in the Flare Site. Preliminary soil remediation goals were proposed for these chemicals in these areas as described below. The responsible parties have proposed no further action for chemicals detected in soils in the other areas of interest at the Project Site for protection of human health or the environment. Final determination on cleanup levels will be established through submittal and approval of the post-remediation risk assessment.

For COCs in groundwater and surface water in the North Valley or South Valley, the screening excess cancer risks ranged from 4×10^{-4} to 1×10^{-6} , and the non-cancer hazard indices ranged from 10 to 0.2. The chemicals that contributed most significantly to the screening risk estimates were either metals that are not believed to be associated with site activities, or chemicals detected infrequently or only in grab groundwater samples that are not considered to be representative of dissolved concentrations in groundwater or surface water at the Project Site.

In most instances, preliminary soil remediation goals were developed for the chemicals in specific areas identified above as contributing most significantly to the screening risk estimates, or for chemicals detected above ambient conditions. The preliminary soil remediation goals for explosives are based on protection of human health. The PRGs for dioxins and metals are based on ambient concentrations, which are also protective of human health. A non-detect value is proposed for the PAHs remediation goal. Although not of concern from a human health perspective, a preliminary soil remediation goal based on ambient concentrations is also proposed for mercury in Demolition Site #3 because mercury was detected above ambient concentrations in this area.

The results of a screening-level assessment indicate that the preliminary soil remediation goals for explosive compounds based on protection of human health will also be protective of ecological organisms. A post-remediation human health

and ecological risk assessment will be conducted to evaluate the risks from residual levels to ensure protection of public health and the environment has been achieved. This risk assessment, to be included in the Implementation Report required by Section 5.13 of the Order, will also be used by DTSC to determine whether any further remedial activities are necessary. The post remediation risk assessment will establish the final remediation goals that will be used to determine if further excavation is warranted.

SUMMARY OF RAOs

The following preliminary soil remediation goals have been established to satisfy the RAOs for the Project Site. As described above, the post-remediation risk assessment will be used to evaluate the residual risk and to determine the appropriateness of the PRGs listed below.

	Preliminary Soil Remediation Goal	Area of Cleanup
<u>Metals in Soil</u>		
Antimony	2.84 mg/kg	Flare Site
Barium	642 mg/kg	Flare Site
Copper	87.7 mg/kg	Flare Site
Lead	148 mg/kg	Flare Site
Mercury	0.77 mg/kg	Demolition Site #3
Zinc	142 mg/kg	Flare Site
<u>Organic Compounds in Soil</u>		
Dioxins	12 pg/g	Flare Site
2,4,6-trinitrotoluene (TNT)	16 (residential) mg/kg	TNT Strips
2,4,6-trinitrotoluene (TNT)	53 (recreational) mg/kg	TNT Strips
2,6-dinitrotoluene (2,6-DNT)	0.5 mg/kg ^(a)	TNT Strips
PAHs: benzo(a)pyrene and dibenz(a,h)anthracene	0.03 mg/kg ^(a) 0.05 mg/kg ^(a)	Stockpiles #1 and #2
Total Petroleum Hydrocarbons	500 (residential) mg/kg	Areas to be determined based on potential underground storage tank

Note: (a) Goals are estimated Practical Quantitation Limit values; because these are lab-specific numbers, they may change when the laboratory for the remedial action phase is selected. It is anticipated that the lab used will be able to achieve similar numbers.

PAH = polynuclear aromatic hydrocarbon

FEASIBILITY STUDY

An FS was completed to identify a range of alternatives to remediate OE and chemically affected soil, and address groundwater at the Project Site. The FS utilized data and analyses generated as part of the RI and screening-level Health Risk Assessment to develop potential alternatives for chemicals of concern in soil.

The FS process was conducted in accordance with EPA guidance (1988), the National Oil and Hazardous Substance Pollution Contingency Plan (NCP) (EPA, 40 Code of Federal Regulations Part 300), and the California Environmental Quality Act (CEQA). This process included identification and screening of remedial technologies and process options, and the development, screening, and analysis of comprehensive alternatives to meet the RAOs and other regulatory requirements.

A total of 13 potential alternatives were initially considered in the FS. These alternatives were screened on the basis of feasibility, implementability, and cost in order to focus on those alternatives with the greatest potential to remediate the Project Site. In addition, the “no action/no project” alternative was evaluated and retained, in accordance with EPA and CEQA guidelines.

Portions of the Project Site are zoned for residential use. Accordingly, only remedial alternatives consistent with residential standards were carried through the full evaluation process in the FS.

The following eight alternatives were carried forward for detailed analysis:

Alternative 1: No Action

Alternative 2: Institutional Controls and Monitoring

Alternatives 5A and 5B: OE point clearance over entire site; areawide OE clearance in the North Valley and Ridge areas having a potential for containing OE intended for future residential use, as well as overburden soil at the north edge of the Unit D-1 lots; excavation, treatment, and disposal of chemically affected soil above Final Remedial Action Goals (FRGs) that will be determined based on results of the post-remediation risk assessment; installation of a layer of crushed bedrock over areawide clearance soils in future residential areas; and institutional controls and monitoring.

Alternatives 6A and 6B: Includes Alternative 5 components plus the excavation of South Valley OE Kick-out Zone soil and placement in the North Valley and adjacent to the South Valley wetlands; with additional geophysical scanning of OE Kick-out Zone soil in lifts during placement.

Alternatives 8A and 8B: Includes Alternative 5 components plus the excavation of South Valley OE Kick-out Zone soil and replacement in the South Valley; with additional geophysical scanning of OE Kick-out Zone soil in lifts during placement in South Valley.

Alternatives 5A, 6A, and 8A include testing of soils during remedial activities, and treatment by homogenization of soils containing TNT concentrations greater than 10 percent to levels acceptable for off-site transport and disposal. Alternatives 5B, 6B, and 8B include composting to treat soil containing TNT to nonhazardous levels acceptable for off-site transport and disposal. If treated soil meets all PRGs, and it

is determined to be acceptable following the post-remediation risk assessment, the soil would be left on site.

The above alternatives were evaluated in detail, in accordance with the nine criteria specified in the NCP and EPA guidance. Alternatives 1 and 2 would not satisfy the RAOs or provide long-term permanent remedies for OE and chemically affected soils at the Project Site. Alternatives 5, 6, and 8 would achieve the RAOs and effectively remediate the Project Site. These alternatives would remediate all areas of interest. Alternatives 5, 6, and 8 vary primarily with respect to the location and quantity of soils in the South Valley that would be remediated for OE using areawide clearance procedures. There would be potential short-term impacts for all alternatives related to excavation and construction activities, and implementation of a minimum separation distance when remediating the Project Site for OE.

Alternative 5A is the recommended alternative. Alternative 5A is the recommended remediation alternative. Alternative 5A has smaller short-term and potential long-term impacts on the South Valley than does Alternatives 6 and 8. Based on comments received on the draft RI/FS Report, Alternative 5A appears to be favored by both the agencies and the community. This alternative would be more implementable and cost-effective than Alternatives 6 and 8. Potential impacts would be managed using various engineering and institutional controls. Alternative 5A would be effective in eliminating the potential pathway for contact with OE in residential areas through application of point clearance, areawide clearance, removal of overburden soil within 14 feet of finished grade, and through placement of a 14-foot-thick layer of OE-free crushed bedrock over areawide clearance soils. In nonresidential areas, the potential exposure to OE would be reduced through the use of institutional controls and other measures, such as zoning changes; and informational devices, such as education/ information programs. Soils found to contain contamination above the PRG and FRG, will be excavated and transported to an appropriate off-site landfill. In some cases (e.g., TNT), pre-disposal treatment to reduce explosive threat may be needed.

Following completion of the remedial activities, water quality (groundwater, subdrain water, surface water, and seeps), soil stability, erosion, wetlands, and institutional controls would continue to be monitored and maintained to verify that conditions do not present any significant health or environmental risks, and that the remedy remains effective. Upon completion of point clearance and soil remediation efforts and the post-remediation risk assessment, institutional controls will be finalized, and final monitoring requirements will be incorporated into a final Operations and Maintenance (O&M) Plan. The final O&M Plan will be included in the O&M Agreement required by Section 5.14 of the Order.

REMEDIAL ACTION PLAN

The public was encouraged to participate in the remedy selection process. The draft RAP was available for review during a 45-day comment period (September 12, 2001 through October 25, 2001) in the public information repository for the Project

Site at the Benicia Public Library at 150 East L Street, Benicia, California 94510; and the DTSC office at 8800 Cal Center Drive, Sacramento, California 95826. Public comments were provided to DTSC at a public meeting held on September 25, 2001. In addition, formal written comments were sent directly to the DTSC office.

An Administrative Record list of documents related to the remedial action described in this RAP is included in Appendix B. The Statement of Reasons, which sets forth the basis for the selected remedial action, and includes the preliminary Nonbinding Allocation of Responsibility and the evaluation criteria, is included in Appendix C. The Responsiveness Summary, which responds to all oral and written public comments on the draft RAP received during the public comment period, is included in Appendix D. Copies of the final CEQA documents for implementation of the remedial measures are available for review at the Benicia Public Library or at the above DTSC office.

The above proposed remedy is based on information provided to date. Should additional information become available through activities proposed herein, or by other means, DTSC will evaluate this information for the purpose of determining whether additional remediation requirements and public review are needed.